CHAPTER 7

DISTRIBUTION SYSTEM DESIGN

7-1. Minimum pipe cover. Minimum cover over pipes will be 2 1/2 feet in grassed areas, 3 feet under unpaved driveways or roadways, and 4 feet under railroad tracks. Where frost depths are greater than the above minimums, the cover should be at least equal to the frost depth, particularly for small lines which may not be flowing continuously. Where lines pass under railroads, pipes may be encased in concrete or enclosed in rigid conduit in accordance with the standard practice of the affected railroad or with the criteria contained in Chapter 1, Part 5 of the American Railway Engineering Association's Manual for Railway Engineering. Installation of pipelines and conduits under railroad main lines is usually accomplished by carefully controlled tunneling and jacking. For branch lines or lines used infrequently, open cut installation may be permitted by the railroad. Jacking or tunneling procedures are usually required if a pipeline is to be installed under a major roadway with no disruption of traffic.

7-2. Protection of items penetrating frost zone. Water distribution equipment items penetrating the frost zone are sometimes subject to freezing if protective measures aren't taken. Air vent and vacuum relief valves, blowoff valves, or fire hydrants are particularly susceptible. Freezing should not be a problem with post-indicator valves and valve boxes if they are constructed and maintained so that water doesn't collect in or around them.

a. Air vent and vacuum relief valves. These items can be protected from freezing by installation in pits deep enough to place the valves below the frost zone or by providing heat with electric space heaters, electric heating tape, or other suitable means.

b. Blowoff valves. Blowoff valves should be installed at depths below the frost zone. If terrain conditions permit, the drain line from a blowoff valve should go to a nearby low surface area to allow gravity drainage. The valve discharge must be piped to the atmosphere and drainage provided from the line to the outlet side of the valve. If gravity drainage can't be provided, the blowoff valve should be provided a tee, with foot valve to prevent backflow, discharging into a dry well below the frost line. Alternatives permitting drainage without contamination from ground water or other nonpotable water may be used subject to approval of the Contracting Officer.

c. Fire hydrants. Fire hydrants penetrating the frost zone will be of the dry-barrel variety (para 5-2). Free draining backfill will be placed around the barrel to prevent frost-heave due to moisture around the barrel in the frost zone.

7-3. Cleaning and lining existing water mains.

a. Where incrustations and tubercules have formed on the inside of mains to such a degree that flow through the mains has been materially reduced, it may be advantageous to clean and line these mains. Cleaning is usually accomplished with special mechanical scraping devices which are pulled through the main with a cable or forced through the main by hydraulic pressure. Large mains, over 30 inches, can be cleaned by electrically-driven, manually-operated machines with rotating scraper blades.

b. After a distribution main has been cleaned, it must be lined with cement mortar or a similar substance. The lining is applied by a special machine on wheels which is pulled through the main and fed the viscuous lining substance under pressure. The lining is centrifugally sprayed onto the interior walls of the pipe by the machine, and the finish is smoothed by special mechanized trowels. The applied linings generally vary in thickness from 3/16 to 1/4 inch, but as little as 1/8 inch might be applied to small diameter mains. In places where the lining cannot be applied and troweled by machine, hand application is necessary. During the cleaning and lining of mains, precautions must be taken to protect any valves, hydrants, or branch mains attached to the main being treated.

c. The principal advantages of cleaning and lining of old mains are that the frictional resistance to flow is reduced, thereby increasing flows and pressures; and the resistance of the pipe material to corrosion is improved. However, before a program of main cleaning and relining is initiated, the relative cost and service life must be compared to the complete replacement of deteriorated mains, and the most cost-effective alternative selected. Standards for

the performance of this work are given in AWWA C602.

7-4. **Disinfection of water supply system.** Disinfection of new distribution mains and disinfection of existing distribution piping affected by construction, or system modifications by construction contract will be in accordance with AWWA C601. In no event will any of the above piping be placed in service prior to verification of disinfection by bacteriological tests as required and evaluated by the supporting medical (health) authority.

7-5. **External corrosion.**

a. Corrosion of the external surfaces of cast-iron or steel pipes can, under some conditions, be a significant problem. Therefore, ductile-iron or steel pipelines placed in corrosive soils must be protected by coatings of coal-tar or cement mortar. Standards for coal-tar coatings are given in AWWA C203 and AWWA C209. Cement mortar coatings may be applied by mechanical or pneumatic means and should meet the guidelines in AWWA C205.

b. The characteristics of the soil in which a pipe is placed affect the rates of corrosion, with the most corrosive soils being those having poor aeration and high values for acidity, electrical conductivity, dissolved solids, and moisture content. The relative potential for corrosion may be estimated by evaluating the degree of corrosion of pipelines or other metallic objects previously buried in that soil. When this information is not available, resistivity tests of the soil should be conducted as described in chapter 8 of TM 5-811-4/AFM 88-p45 and results evaluated in accordance with paragraph 3-05d therein to determine the required degree of cathodic protection, or restrictions on piping materials permitted to be used.

c. In locations where the soils are known to be very corrosive, it may be desirable to use cathodic protection systems as a supplement to (but not in place of) the above coatings. Requirements for corrosion control and criteria for cathodic protection of buried utilities and structures are given in TM 5-811-4/AFM 88-45. Additional criteria is given in AFM 88-15.

d. Another method of avoiding corrosion of distribution mains is through the use of nonmetallic pipe materials such as asbestos-cement, reinforced concrete, or plastic.

7-6. **Thrust blocking.** Criteria for determining the magnitudes of thrusts and the relative need for thrust blocking or anchorage are given in appendix C.

7-7. **Standard details.** Construction details are shown on OCE Standard drawing No. 40-07-22. This drawing is available at HQDA(DAEN-ECE-A) WASH DC 20314-1000.

7-8. **Layout map.** An up-to-date layout map, to a suitable scale, showing the entire distribution system involved in the design will be maintained.

7-9. **Design analysis.** The design analysis will indicate the essential elements used in determining sizes and locations of mains, including:

Projected populations and areas in which the populations are located

Locations and magnitudes of special water demands

Location and magnitude of fire demands

Location and size of pump stations
Storage input

Water treatment plant or other input sources